REMARKS

In an Office Action dated July 23, 2010, claims 1-4 of the present application were rejected. Applicants respectfully request reconsideration based on the following remarks.

I. Prosecution History of the Present Application

A first Office Action on the merits was mailed on February 5, 2009 in which claims 1-4 were rejected. An Amendment was filed in response on June 4, 2009, in which a minor claim amendment was made to claim 1 in order to improve its US form along with remarks asserting the patentability of the claimed invention.

A Final Office Action was mailed on September 11, 2009 maintaining the rejection of claims 1-4. An After-Final Amendment was filed in response on February 12, 2010, in which a replacement sheet for Figure 1 was provided to correct a clerical error, a Declaration under Rule 1.132 was provided presenting evidence for the patentability of the claimed invention, and remarks were provided asserting the patentability of the claimed invention.

An Advisory Action was mailed on February 25, 2010 maintaining the rejection of claims 1-4, and indicating that the Declaration under Rule 1.132 would not be entered. A Request for Reconsideration was filed in response on March 11, 2010, along with a Request for Continued Examination requesting entry of the Declaration under Rule 1.132, in which remarks were provided asserting the patentability of the claimed invention.

A non-final Office Action was mailed on April 13, 2010 maintaining the rejection of claims 1-4. A Request for Reconsideration was filed on July 13, 2010 in which further remarks were provided asserting the patentability of the claimed invention.

A final Office Action was mailed on July 23, 2010 maintained the rejection of claims 1-4. The remarks presented herein are in response to the final Office Action.

II. Claim Rejections under 35 U.S.C. 103(a)

Claims 1-4 were rejected under 35 U.S.C. 103(a) as being unpatentable over Badard (WO 03/012156). Reconsideration of the above rejection is requested in view of the following.

Claim 1 recites steel for mechanical components, wherein the composition thereof is, in percentages by weight: $0.19\% \leq C \leq 0.25\%$; $1.1\% \leq Mn \leq 1.5\%$; $0.8\% \leq Si \leq 1.2\%$; $0.01 \leq S \leq 0.09\%$; trace levels $\leq P \leq 0.025\%$; trace levels $\leq Ni \leq 0.25\%$; $1\% \leq Cr \leq 1.4\%$; $0.10\% \leq Mo \leq 0.25\%$; trace levels $\leq Cu \leq 0.30\%$; $0.010\% \leq Al \leq 0.045\%$; $0.010\% \leq Nb \leq 0.045\%$; $0.0130\% \leq N \leq 0.0300\%$; and optionally trace levels $\leq Bi \leq 0.10\%$ and/or trace levels $\leq Pb \leq 0.12\%$ and/or trace levels $\leq Te \leq 0.015\%$ and/or trace levels $\leq Se \leq 0.030\%$ and/or trace levels $\leq Ca \leq 0.0050\%$.

Applicants acknowledge that ranges of certain elements of the claimed steel composition lie within corresponding ranges disclosed by Badard. However, Applicants emphasize that the particular ranges of claim 1 achieve unexpected results relative to the broader prior art range.

MPEP 2144.05(I) states that a prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a *prima facie* case of obviousness. However, MPEP 2144.05 (III) provides that an applicant can rebut a *prima facie* case of obviousness by showing that the claimed invention achieves new and unexpected results relative to the prior art.

1. Applicants' Previous Arguments

In the Amendment filed on June 4, 2009, the After Final Amendment filed on February 12, 2010, the Request for Reconsideration filed on March 11, 2010, and the Request for Reconsideration filed on July 13, 2010, Applicants presented remarks explaining the unexpected results of the presently claimed invention relative to the prior art. In particular, Applicants noted that the ranges recited by claim 1 are critical to producing an optimal Jominy curve for a steel composition, and that the selection of the contents of the main alloy elements is intended to achieve a Jominy curve with no significant marked inflection point. Applicants noted that page 6

of the specification discloses the benefits of such a Jominy curve as allowing minimal deformation to be achieved during a quenching operation.

Additionally, Applicants have presented comparative examples in view of Figure 1 of the present application. In particular, Applicants noted that the curves corresponding to the samples within the claimed range (i.e., curves E, F, and G) lack a significantly marked inflection point in contrast to the curves corresponding to the samples outside the claimed range (i.e., curves A, B, C, and D). Applicants stressed that the curves corresponding to the samples within the claimed ranges are straighter and less steep, thereby indicating that the hardness is less dependent on the depth at which it is measured.

In this regard, Applicants noted that page 6 of the specification states that a composition of steel which produces a Jominy curve with no inflection point is advantageous for greatly reducing deformations during a quenching operation following a carburizing operation, and page 14 of the specification states that curves E, F, and G are defined as having no marked points of inflection. As such, it is apparent that the specification indicates that the inventive steel compositions corresponding to curves E, F, and G are to be interpreted as having no marked points of inflection. Therefore, in view of pages 6 and 14 of the specification, the inventive samples corresponding to curves E, F, and G greatly reduce deformation during a quenching operation following a carburizing operation relative to the reference samples corresponding to curves A, B, C, and D, regardless of whether curves E, F, and G have a slight point of inflection.

Further, Applicants noted that pages 14-22 of the specification describe various carborizing tests in which the inventive steel compositions are compared to the reference steel compositions. For example, the specification indicates that the inventive steel compositions reduce carborizing time (pages 20 and 21), increase carborizing depth (page 18, 21), improve core hardness (pages 16, 18), improve energy at break (pages 20 and 21), and increase the fatigue properties (pages 17, 19, 22) relative to the reference steel compositions.

2. Examiner's First Response to Arguments

In response to the above arguments, the Examiner indicated on page 6 of the Office Action that the evidence submitted has not compared the claimed subject matter with the closest prior of the actual Badard reference applied under 35 U.S.C. 103(a). In this regard, the Examiner has taken the position that the closest example is that shown in Table 3 of Badard in view of claim 3 of Badard. However, Applicants respectfully submit that the presently claimed invention achieves unexpected results over the closest example cited by the Examiner.

In this regard, Applicants note that the closest example cited by the Examiner (i.e., Table 3 of Badard in view of claim 3 of Badard) requires: 0.008 - 0.05 wt% of Al; 0.02 - 0.05 wt % Nb; and 0.007 - 0.025 wt% N.

In contrast, claim 1 requires: 0.010 - 0.045 wt % Al; 0.010 - 0.045 wt % Nb; and 0.013 - 0.030 wt % N. As such, Applicants note that the ranges of the above-noted elements in the closest example cited by the Examiner are surely or very possibly not within the narrowly defined ranges required by claim 1.

In this regard, Applicants note that the specification clearly states (in multiple locations) that the presence of Al, Nb, and N within the narrowly defined ranges is very important for controlling grain size, and in particular, very important during the carburization step which precedes the quenching (*See* at least pages 10-12 of the Specification stating, for example, "[t]he aluminum, niobium, and nitrogen contents thereof must be controlled within precise limits.").

Further, Applicants respectfully submit that based on the above-noted specification described influences of Al, Nb, and N on the shape of the Jominy curve, a Jominy curve for the closest sample cited by Examiner would be not rectilinear or at the very least would have a significant marked inflection point. As such, Applicants note that the closest example cited by the Examiner would result in excessive deformations of the steel during quenching in contrast to the unexpected results of the presently claimed invention.

Applicants submit the above assertion is supported by the specification as originally filed in which comparative sample D has a composition very similar to what is required by the presently claimed invention. In this regard, Applicants note the differences between comparative sample D and the presently claimed invention is that the Cr content of the comparative sample D is slightly lower than that required by claim 1 (0.98% and at least 1%, respectively), and that the N content of comparative sample is lower than that required by claim 1 (0.09% and 0.013 - 0.030%, respectively). Also, Applicants note that the 0.09% N is within the range required by the closest sample cited by the Examiner.

In this regard, Applicants note that comparative sample D has a Jominy curve with a significant marked inflection point at a depth of about 6-7 mm. As such, Applicants respectfully submit that this clearly shows that the N content is fundamental to the presently claim invention.

In view of the above, Applicants note that the criticality of the claimed ranges of Al, Nb, and N is clear from the specification, and that in view of the required range of Al, Nb, and N of the closest example cited by the Examiner, Applicants respectfully submit that the closest example cited by the Examiner cannot achieve the unexpected results of the presently claimed invention. Therefore, Applicants respectfully submit that the presently claimed invention achieves unexpected results over the closest example cited by the Examiner.

3. Examiner's Second Response to Arguments

Further, Applicants note that on pages 6 and 7 of the Office Action, the Examiner indicates that all the reference steel samples (i.e., samples A, B, C, and D) have alloy composition ranges lower than those recited by claim 1, and that "to demonstrate that the purported unexpected results occur over the entire range of claim 1, comparative examples having alloying elements present in amounts greater than claimed are needed to establish that the unexpected results apply to the upper limits of the claimed ranges of instant claim 1."

Applicants note that while the specification does not disclose comparative steel samples having alloying elements present in amounts greater than claimed, the specification does teach that samples having alloying elements present in amounts greater than claimed would not

achieve the results of the presently claimed invention, and therefore, Applicants respectfully submit that comparative samples having alloying elements present in amounts greater than claimed are not needed to illustrate the unexpected results of the presently claimed invention (i.e., the specification itself does provide evidence of the criticality of the upper limits of the invention).

In this regard, Applicants note that at pages 8-12 of the specification as originally filed, the specification provides sufficient detail concerning the upper limits of the alloying elements in the presently claimed invention. For example, the specification indicates the following:

-with more than 0.25% of C, the steel would not be easily machinable as a result of the steel being too hard;

-with more than 1.25% of Mn, segregations would appear during the annealing, and, the liquid steel would excessively corrode the refractory coating of the ladle containing liquid steel;

-with more than 1.2% of Si, the segregations and the risks of oxidation during carburization would increase;

- with more than 0.01% of S, the hot forgeability would be lowered;

- with more than 0.025% of P, the upper limits set by the standards ruling the steel grades(to which the steel of the invention belongs) would be exceeded, and the interaction with Nb would make the tool too brittle;

- at more than 1.40% of Cr the cost of the steel would be needlessly increased;

- at more than 0.3% of Cu, the ductility and the core strength would be lowered;

- at more than 0.45% of Al, the oxide inclusions would be too numerous; and

- at more than 0.045% of Nb, there would be a risk of cracking due to an interaction with P.

In view of the above, Applicants note that the motivation for the choices for the upper limits of the alloying elements are <u>not</u> linked to the obtaining of a Jominy curve with a gentle slope and no significant marked inflection point, but that the choices for the upper limits of the alloying elements are based on classical metallurgical motivations.

As such, Applicants note that the upper limits are chosen for reasons which are not specifically related to the problem solved by the invention, and thus, Applicants respectfully submit that comparative samples having alloying elements present in amounts greater than claimed are not necessary for illustrating the unexpected results of the presently claimed invention since it would be obvious to one of ordinary skill in the art that steels having alloying elements present in amounts greater than claimed would not be satisfactory for their intended purpose for reasons well known to metallurgists.

In view of the above remarks and the previously provided Declaration under Rule 1.132 describing the advantages of the inventive steel compositions, Applicants respectfully submit that the steel composition ranges of claim 1 achieve unexpected results relative to the broader prior art range disclosed by Badard. Therefore, claim 1 is patentable over Badard.

Further, claims 2-4 are patentable over Badard based at least on their dependency from allowable claim 1.

III. Conclusion

In view of the foregoing remarks, Applicants respectfully submit that claims 1-4 are clearly in condition for allowance. An early notice thereof is earnestly solicited.

If, after reviewing the above remarks, the Examiner believes that there are any issues remaining which must be resolved before the application can be passed to issue, it is respectfully requested that the Examiner contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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2010.10.25 13:38:29 -04'00'

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October 25, 2010